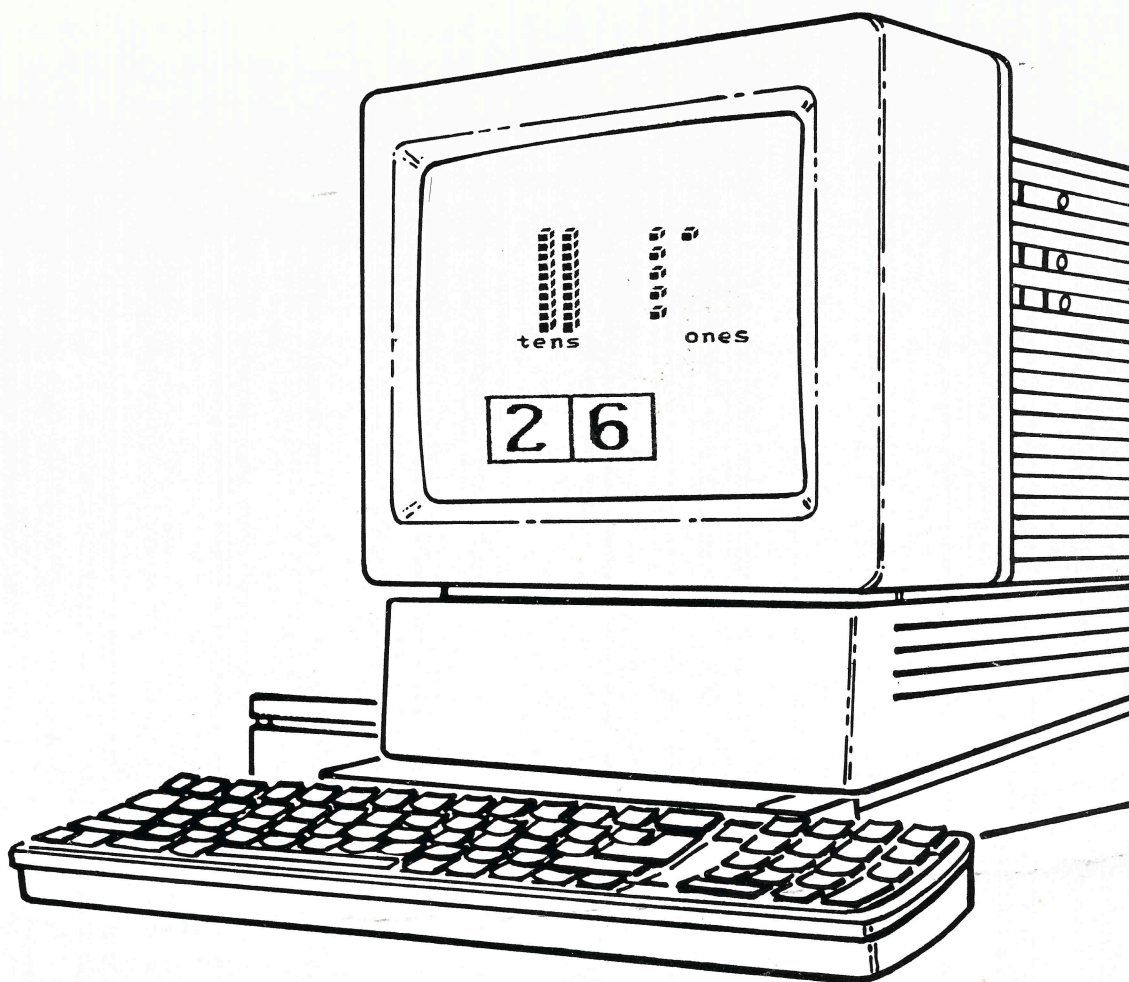


# EME



## PLACE VALUE

### STUDY GUIDE

by

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# EME

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## OVERVIEW

The E.M.E PLACE VALUE program consists of two parts:

Part 1 gives students an in-depth familiarity with the concept of place value, one of the cornerstones of our numeration system. It provides extensive practice and experience with numbers up to three digits, using three modes of representation: blocks, numerals and words. A convenient forward-backward feature allows review.

Part 2 is Cube Trader, an exciting game offering a wealth of opportunities to manipulate numbers and use place value. It may be played by 1, 2 or 3 students.

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## OBJECTIVES

PLACE VALUE will help students to:

1. Increase their knowledge of and familiarity with our basic system of numeration.
2. Write the numeral representing a given quantity of blocks.
3. Show in blocks the equivalent of a number written in numerals or written in words.
4. State the number of 1s, 10s and 100s in numbers represented by blocks, by numerals and by words.
5. Make a block representation of and write the numeral corresponding to a given number of 1s, 10s, and 100s.
6. Become adept at working with the whole number combinations of 10. ( $1 + 9$ ,  $2 + 8$ ....)
7. Increase their enjoyment of arithmetic.

## BACKGROUND

Our numeration system is a place-value system -- that is, the value of a digit depends on where it appears in a numeral. As adults, we think in place-value terms automatically. We know the 3 in 348 stands for 300, the 3 in 438 means 30, and the 3 in 123 is just 3. It is easy to underestimate the difficulty children have in acquiring the familiarity we take for granted.

An encounter with Roman numerals makes us appreciate the difficulties of a system that uses place value only minimally. Consider the Roman numeral for 348:

CCCXLVIII

The three Cs are the equivalent of the 3 in 348; the XL (50 take away 10) of the 4; and the VIII of the 8. Compared with our decimal numeration system, writing the Roman numeral is difficult, decoding it is more difficult and doing multiplication or division is extremely complex.

Mathematics educators generally agree that manipulative materials are the foremost tool for teaching place value. A great variety of blocks has been used with varying degrees of effectiveness. A problem with some types of blocks is inflexibility. A 10-stick is permanently a 10-stick; a 100-block is permanently a 100-block.

A computer has the ability to represent 10-sticks and 100-blocks in such a way that they can readily be rearranged into their components. A 10-stick becomes 10 ones; a 100-block becomes either ten 10-sticks or 100 ones and vice versa.

The program PLACE VALUE should be viewed not as a replacement for manipulative materials in the teaching of place value, but rather as a valuable adjunct. It is outstanding in its ability to present and interrelate the three different ways numbers are seen by young children -- as numerals, in words, and as represented by physical objects (blocks or counters).

#### PART 1 - PLACE VALUE

All students should start with Part 1. This ensures that they have both exposure to and practice with place-value concepts. A student should be able to go through Part 1 with a minimum of difficulty before going on to Cube Trader. The game will then be more meaningful and enjoyable.

At the beginning of Part 1, numbers are in the two-digit range. Three-digit numbers are used later in Part 1 and in Cube Trader. The program is designed for Grades 2

and up. When using an Apple IIe or IIc, be sure CAPS LOCK key remains down.

Throughout Part 1, a student may ask the program to "translate" a number written in numerals or words into its representation by blocks. This is done by pressing the "P" key. It can be invaluable to students who have difficulty understanding the symbols used for numbers.

If certain students become so expert at the place value exercises in Part 1 that further repetition is pointless, they can move to the game from the starting Menu by pressing the numeral 2.

## PART 2 - THE CUBE TRADER GAME

Before beginning to play Cube Trader, all students should go through the Instructions section and look at the sample plays. The few minutes so spent will make the game experience far more satisfying.

In Cube Trader, the top of the screen is called the player's "board". The left side is for 100-blocks; the center is for 10-sticks; the right side is the ones pile. Each player tries to be the first to trade for a 100-block. If 2 or 3 players obtain 100-blocks after an equal number of turns, the player with the highest number of cubes is the winner.

On each turn, a random number of cubes (3 - 12) go into the player's Bank. Five different moves are available during each player's turn:

1. Move cubes from the Bank to the ones pile on the board.
2. Move cubes from ones pile to the Bank.
3. Move ten or twenty cubes from the Bank to make one or two 10-sticks on the board.
4. Trade ten 10-sticks on the board for one 100-block.
5. End the turn.



Playing Cube Trader involves both skill and luck. The best move or moves depend on what the player already has on the board and the number of blocks received by the player's Bank.

If the number of cubes in a player's Bank is less than 10, the player must decide "Between the ones in my ones pile and those in the Bank, do I have enough to build the Bank up to 10?" If so, enough ones are moved to the Bank to bring the Bank to 10. Then the 10 ones from the Bank are moved to the 10s pile on the board. This earns a BONUS of 4 cubes.

NOTE: Occasionally, a player can build the number in the Bank up to 20 and make two 10-sticks on the board. This also earns a 4-cube BONUS.

If the number in the Bank is less than 10 and the player does not have enough ones to build it up to 10, the cubes are simply moved from the Bank to the ones pile.

If the number in the Bank is 10, 11 or 12, and the player cannot build the number up to 20, 10 cubes are moved up to become a 10-stick on the board. Any remaining ones are moved to the ones pile.

When a player ends a turn with 10 or more cubes in the ones pile, a 4-cube PENALTY is assessed for failing to make the trade. The 10 ones should have been moved to the Bank and a 10-stick moved to the 10s pile. The same penalty applies if a player ends a turn with ten or more 10-sticks in the 10-pile. They should have been traded for one 100-block.

#### PROGRAM APPLICATIONS

Learning about place value and practicing with it are valuable for virtually all children in the middle years of elementary school. Some students may go through Part 1 easily. Others will take more time to complete it, but almost all students will find the experience useful. It is likely that students needing remediation in mathematics will be the biggest gainers from exposure to Part 1, whatever their grade

placement may be.

The optimum arrangement for Part 1 is one or two students per computer; three students per computer is possible but not recommended. Fifteen or twenty minutes per session is practical. Encourage students to verbalize to themselves or their partner each step as they manipulate numbers of blocks.

If students have difficulty with either Part 1 or Part 2, encourage them to move actual 100-blocks, 10-sticks and 1-cubes in the same way these are moved on the screen.

The Cube Trader game may be played by 1, 2 or 3 students. With 2 or 3 students there is the challenge of who gets 100 or more cubes first. In the solitaire game, students can be encouraged to set a record for the least number of turns taken to get a 100-block.

#### ADDITIONAL ACTIVITIES

1. Have students investigate ancient numeration systems such as Babylonian or Mayan and report on how place value was handled in each.
2. Provide as much opportunity as possible for students to represent and work with numbers through manipulative materials, such as:

- Blocks that represent 100s, 10s and 1s
- Interlocking cubes
- Coins (dimes and pennies; or quarters, nickels and pennies)
- Colored chips
- Tongue depressors (some as 1s, some banded into 10s and 100s)

3. Familiarize students with the use of the abacus and other devices where columns represent different place values.
4. Advanced students may enjoy working with number systems based on 2, 5 or another non-decimal base.

## GLOSSARY

decimal: Based on the number 10.

digit: One of the numbers from 0 through 9.

number: The aspect of a group that can be counted.

numeral: A figure or character, or group of either, used to express a number.  
Examples: 2, 14, 237.

place value: The value of digits as determined by their position in numbers.

quantity: Total amount or number.

symbol for a number: A conventional sign used to represent a number.

written number: A number named with words. Examples: forty, sixty-seven.

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